CLAIMS

What is claimed is:

1. A color sensing device for sensing light emitting from a target surface, the device comprising:

three or more light sensors, each sensor configured with a bubble shaped lens and adapted to detect light from the target surface;

a sensor locating element having three or more light passages and corresponding alignment holes, each hole adapted to receive a corresponding one of the bubble shaped lenses, thereby aligning each sensor with a corresponding light passage;

a tube block operatively coupled in alignment with the sensor locating element, the tube block having three or more filter cavities and corresponding light passages, each light passage in alignment with a corresponding light passage of the sensor locating element; and

three or more distinct light filter stacks including one or more filter elements, each filter stack placed in a corresponding one of the filter cavities, thereby providing three or more overlapping spectrally selective channels, with each spectrally selective channel designed to provide a pre-defined field of view between the target surface and a corresponding one of the light sensors.

2. The device of claim 1 wherein each spectrally selective channel is designed to provide a field of view between each sensor and the target surface in the range of +/- 5 to 7 degrees.

3. The device of claim 1 wherein the three or more light sensors include three light-to-frequency sensors for characterizing the target surface.

4. The device of claim 1 wherein the three or more light sensors include a light-to-voltage sensor for characterizing the target surface without the use of filters.

5. The device of claim 1 wherein each of the three or more light sensors has a planar locating surface that mates with a surface about a corresponding one of the alignment holes of the sensor locating element, thereby aligning a plane of the target surface and a plane of the sensors.

6. The device of claim 1 wherein the sensor locating element is further configured with one or more crushable ribs proximate each alignment hole, thereby enabling maximum clamping pressure on each filter stack with minimum deformation of filter elements.

7. The device of claim 1 further comprising a lead frame PCB assembly configured with soldering points for electrically connecting the sensors, and alignment holes adapted to couple with alignment pins of the tube block, thereby further contributing to self-aligning qualities of the device.

8. The device of claim 1 further comprising a clamping block configured with three or more pressure bumps adapted to apply clamping pressure to the sensors during assembly of the device.

9. The device of claim 8 wherein during final assembly of the device, a clamping screw travels through at the clamping block and sensor locating element, and threads into a clamping screw hole in the tube block at a pre-defined torque.

10 The device of claim 8 wherein each sensor has a surface that includes an inward dimple that is adapted to receive a corresponding pressure bump of the clamping block, thereby further contributing to self-aligning qualities of the device.

11 The device of claim 1 further comprising a sensor shield adapted to prevent extraneous light from corrupting measurement accuracy.

12. A color sensing device for sensing light emitting from a target surface, the device comprising:

a tube block having one or more filter cavities and corresponding light passages, and two or more alignment pins, thereby enabling a self-aligning fabrication process for the device;

one or more light sensors, each sensor configured with a bubble shaped lens and adapted to detect light from the target surface; and

a sensor locating element operatively coupled to the pins of the tube block, the sensor locating element having one or more lens alignment holes, each hole adapted to receive a corresponding one of the bubble shaped lenses, thereby aligning each sensor with a corresponding light passage of the tube block.

13. The device of claim 12 further comprising:

one or more light filters, each filter placed in a corresponding one of the filter cavities, thereby providing one or more spectrally selective channels, with each spectral channel designed to provide a pre-defined field of view between the target surface and a corresponding one of the light sensors.

14. The device of claim 13 wherein the sensor locating element is further configured with one or more crushable ribs proximate each alignment hole, thereby enabling maximum clamping pressure on each filter with minimum deformation of filter elements.

15. The device of claim 13 wherein the one or more spectral channels are non-overlapping, thereby enabling tri-stimulus measurements.

16. The device of claim 12 wherein the device has a field of view between each sensor and the target surface that simulates a human eye field of view.

17. The device of claim 12 wherein each of the one or more light sensors has a planar locating surface that mates with a surface about a corresponding one of the alignment holes of the sensor locating element, thereby aligning a plane of the target surface and a plane of the sensors.

18. The device of claim 12 further comprising a lead frame PCB assembly configured with soldering points for electrically connecting the sensors, and alignment holes adapted to couple with alignment pins of the tube block, thereby further contributing to self-aligning qualities of the device.

19. The device of claim 12 wherein each sensor has a surface that includes an inward dimple, and the device further comprises a clamping block configured with one or more pressure bumps, each bump adapted to engage a corresponding dimple, thereby further contributing to self-aligning qualities of the device.

20. A method for fabricating a color measurement device, the method comprising:

providing a tube block having one or more filter cavities and corresponding light passages, and two or more alignment pins, thereby enabling a self-aligning fabrication process for the device;

placing each of one or more filter stacks in a corresponding one of the filter cavities, thereby enabling one or more spectrally selective channels;

placing a sensor locating element on the alignment pins of the tube block, the sensor locating element having one or more alignment holes each adapted to receive a bubble lens of a light sensor; and

placing one or more bubble lens light sensors on the sensor locating element, so that each bubble lens is received into a corresponding one of the alignment holes, thereby aligning each sensor with a corresponding light passage of the tube block.

21. The method of claim 20 further comprising:

torquing a clamping screw into the tube block so as to secure components of the device and to crush one or more crushable ribs proximate each alignment hole, thereby enabling maximum clamping pressure on each filter stack with minimum deformation of filter elements using one or more.

22. The method of claim 20 further comprising:

mating a planar locating surface of each of the one or more light sensors with a surface about a corresponding one of the alignment holes of the sensor locating element, thereby aligning a plane of the target surface and a plane of the sensors.

23. The method of claim 20 further comprising:

placing a lead frame PCB assembly configured with alignment holes on alignment pins of the tube block, thereby further contributing to self-aligning qualities of the device.

23. The method of claim 23 further comprising:

soldering leads of the sensors to contact points of the lead frame PCB assembly after torquing of a clamping screw has secured components of the device.

24. The method of claim 20 wherein each sensor has a surface that includes an inward dimple, the method further comprising:

placing a clamping block configured with one or more pressure bumps on alignment pins of the tube block, so that each pressure bump engages a corresponding dimple, thereby further contributing to self-aligning qualities of the device.